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PRESENTED BY  
PROF. Q. M. F. NUTTALL



*Bradford Corporation*

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*Esholt  
Sewage Disposal  
Scheme*



1912

PRICE—SIXPENCE.

19776



Bradford Corporation

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*Esholt*  
*Sewage Disposal*  
*Scheme*



1912



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Alderman  
John Batt Moorhouse,  
J.P.,  
Lord Mayor.



Miss Moorhouse,  
Lady Mayoress.







Alderman  
Richard Johnson, J.P.,  
Chairman.



Councillor John Garnett,  
Deputy-Chairman.







#### MEMBERS OF THE SEWAGE COMMITTEE.

- (1) Councillor E. Fattorini. (2) Alderman H. B. Priestman, J.P. (3) Alderman F. Foster, J.P.  
 (4) Councillor J. B. Wilkinson. (5) Councillor E. J. Smith. (6) Alderman E. Cash, J.P.  
 (7) Councillor A. W. Brown. (8) Councillor A. Cowling. (9) Councillor A. F. Paine.  
 (10) Councillor T. Grundy. (11) Councillor A. T. Sutton. (12) Alderman J. E. Fawcett, J.P.  
 (13) Alderman A. Gadie. (14) Alderman Wm. C. Lupton, J.P. (15) Councillor J. Hustler.





Joseph Garfield, Assoc. M. Inst. C.E.,  
Sewage Works Engineer.



James Watson, M. Inst. C.E.,  
Waterworks Engineer.

(Joint Engineers for the Main Outfall Sewer and Aire Valley Crossing.)



Howard Wontner Smith, Assoc. M. Inst. C.E.,  
Resident Engineer.





Frederick Stevens,  
Town Clerk.



Norman L. Fleming,  
Deputy Town Clerk.







# *BRADFORD SEWAGE DISPOSAL.*

## *THE ESHOLT SCHEME.*



THE Esholt scheme is the culmination of many years of effort by the citizens of Bradford to deal with the problem of sewage disposal. The situation of the city, the history of its development, and the character of the industries in which a large proportion of its population are engaged are all factors which have combined to give to the local sewage problems almost unique complexity.

When three parts of the eighteenth century had passed Bradford still remained much what it had been from mediæval times—a tiny market town of two or three thousands of inhabitants, with some traditional interest in the textile trade, but mainly of agricultural character. At the end of the nineteenth century it had attained to the rank of a great industrial city of 280,000 persons. The

settlement of the colonies has presented in recent years more impressive examples of town development, but those municipalities have been planned from the beginning, and in places presenting natural opportunities. These are the reverse of the conditions in Bradford, where the fortuitous cart-tracks and lanes of the past settled the lines and too often the width of the streets, and where ancient legitimate and equitable interests presented a hundred awkward problems in town-building. Moreover, the expansion of Bradford was probably unparalleled in this country in the time of its greatest activity : and it was unforeseen and in no way provided for.

In the early days of small things a very simple sanitary ideal sufficed. The houses nearest the water-courses—the Bradford beck and its tributaries—turned their sewage into those becks and it mattered nothing even to the trout. Householders at greater distance followed such course of sewage disposal as their ingenuity suggested, trusting the breezes to make good defects of science. When the factory system changed the whole face of the community Bradford was for a generation or two unable to realise all that the change involved. The nation as a whole was slow in awakening. The principles of the conservation of the public health had not been evolved ; municipal bodies were without adequate powers, without an understanding of their vast opportunities, and the daily growing burden of their duties was paralysing rather than stimulating.

## Bradford in Village Days.

So until far into the nineteenth century the sanitary condition of Bradford was deplorable. An experienced government officer, who was engaged during some years in getting the material which resulted in the Public Health Act of 1848, came to Yorkshire in 1843, and he declared in his report that, bad as were many industrial communities, Bradford was "the most filthy town I visited." There was not a public sewer in the place. Pre-historic private drains served the houses in the principal streets, while the sewage of the inferior streets ran into open channels. The chief commercial advantage of the town—its canal—added to the insanitation. In the middle of the eighteenth century a branch of the Leeds and Liverpool Canal had been carried up the Bradford valley and had its terminal basin partly upon the site of what is now Forster Square. Here sluice-gates intercepted the water of the Bradford beck. The consequence was that the stagnant pool became the recipient of vast quantities of sewage. "The water of the basin" said the inspector already quoted "is often so charged with decaying matter that in hot weather bubbles of sulphuretted hydrogen are continually rising to the surface; and so much is the atmosphere loaded with gas that watch-cases and other materials of silver become black in the pockets of the workmen employed near the canal. The stench is sometimes very strong and fevers prevail all around." This was in 1843.

The Rivers Pollution Commission which sat for some years in the 'sixties described the canal-basin as "so corrupt that large volumes of inflammable gases were given off, and although it had usually been considered an impossible feat to 'set the River Thames on fire' it was found practicable to set the Bradford canal on fire, as this at times formed part of the amusement of boys in the neighbourhood. They struck a match placed on the end of a stick, reached over, and set the canal on fire, the flames rising six feet high and running along the surface of the water for many yards, like a will-o'-th'-wisp ; canal boats had been so enveloped in flame as to frighten persons on board.'" In other respects the condition of the town left much to be desired.

### A Sanitary Renaissance.

Before this rather sensational but probably not exaggerated description was published the inhabitants were alive to the dangers. A charter of municipal incorporation was secured in 1848, and very soon after the coming of cholera impressed on the new Town Council the necessity of attention to sanitation. In 1853 the Borough Surveyor, the late Mr. Charles Gott, M.Inst.C.E., laid down the line for a main trunk sewer, but from various causes it was not till nine years later that any progress was made with its construction. In 1862 the first mile of sewer was laid ; in the next year two miles ; in the third year four miles, and by 1870 thirty miles had been completed. The work since then has



never ceased, and Bradford has now (1912) no less than 115 miles of sewer in the area of the old borough, not including the recently added townships. Besides this the Corporation caused the beck in its course through the town to be paved and covered in, and in 1866 it dealt with that festering plague spot the canal basin. Action was taken in Chancery to prevent the Canal Company utilising the sewage-charged waters of the beck to feed their navigation water. For awhile this involved the closing of the canal to traffic, but eventually pumping stations were established, which enabled the higher reaches of the canal to be fed with pure river water.

But all these sanitary measures proceeded upon the primitive principle that the river was the natural place into which the sewage should be poured, and the more efficient the drainage of the town, the worse became the condition of the Beck and of the River Aire into which it flowed—that condition, of course, being intensified by the fact that other industrial communities on the banks of the Aire were rapidly rising and were also utilising the river for sewage disposal.

### The Local Difficulties.

The woolcombing industry which developed with extraordinary rapidity in the town in the middle of the century added peculiar difficulties. Wool and hair were—and still are—brought to Bradford from all parts of the world in the crude state as they are clipped from the backs of the animals. Before being combed the wool is washed, and in that process it

loses in many cases as much as 60 per cent. of its weight, that 60 per cent. consisting partly of the natural fat and partly of the dirt and manure clinging to the fleeces. As a consequence the effluent from the woolcombing water is extremely "rich" in organic materials and it is also very offensive. It is indicative of the magnitude of the problem which this trade creates that no less than one-fifth of the wool produced in the whole world is to-day (1912) washed and dealt with in the area of this single municipality.

As the wool trade increased in Bradford protest was made by the residents on the river banks against the growing nuisance. In 1868 Mr. William Rookes Crompton Stansfield, the owner of the Esholt Hall and estate, took legal action in the Court of Chancery. He asked that the Corporation should be "restricted from causing or permitting to pass any sewage or other offensive matter into Bradford Beck in such a manner that the same may pass into the River Aire to the injury of the plaintiff, or to the pollution of its course past Esholt Hall estate, or into the river at all."

The Town Clerk (the late Mr. W. T. McGowen) presented to the Court a view of the difficulties in which the Bradford Corporation found themselves. All schemes of precipitation or deodorization of sewage at that time invented had proved unworkable on a large scale. The Royal Commission on Rivers Pollution, which had been severe on Bradford's sanitary condition, had been appealed to for useful advice and aid, but "the Royal Commissioners



were at a loss how such cases should be dealt with," and Mr. McGowen argued "if the most able officers whom the Government could select were thus embarrassed"—what could Bradford do? The only project ingenuity could devise—an expedient of despair—was the construction of a vast sewer which should take the sewage of the whole of the industrial district of Yorkshire in the valleys of the Wharfe, Aire, and Calder, away down to the sea. But this was too big a scheme for the Government to sanction or aid.

The Court realised the difficulty and, without acceding to the demand that it should forbid the passage of Bradford sewage into the river at all, it attempted to forbid any intensification of the nuisance. It prohibited under penalty of £10,000 "the opening or permitting to be opened any additional sewer or any house drain into the sewer." This setting, Canute-fashion, of a line—"Thus far and no further" to the tide of Bradford's commercial development satisfied nobody. It made the river no more tolerable to Mr. Stansfield, and it rendered Bradford's position very difficult. For no house could be erected and properly drained. In the ensuing year, as a result of negotiations between the Corporation and Mr. Stansfield, the prohibition of the Court was relaxed, and Bradford entered upon an era of experiments in sewage treatment.

These experiments were made at Frizinghall, the lowest point within the borough. Here eleven acres of land were purchased and works, completed in 1873, were constructed. The first effort was a

private adventure. A company undertook the treatment of the sewage free of cost. Their advisers proposed to filter the liquid through peat charcoal, and they calculated upon a handsome profit by the sale to the farmers of the residual as manure. The Corporation undertook to construct works and provide them rent free, and a lease was signed of the sewage to the company for twenty-one years. But after losing £30,000 in their experiments the company came to grief. The Corporation then in 1874 took the works into their own hands, and appointed a manager to superintend the purification processes.

### The Trouble of Wool Fat.

If the exceptional strength of the Bradford Sewage in the common organic elements had been its only peculiar quality the task of sewage treatment would still have been difficult. But beside the dirt there was taken from the fleeces in wool-washing an immense quantity of wool fat—known in the refined state as Lanoline. At one stage of the commercial development of the borough it paid the woolcomber to extract part of the fat from his effluent, but as the quantity of wool dealt with increased, the price of the residual grease declined, and eventually nearly all the effluent was passed entirely untreated into the sewers. The estimated quantity of this grease thus poured into the beck was, in 1889, stated at from twenty-five tons a day when the wool trade was suffering a bad time, to fifty tons a day or more in prosperous times. In addition, of course, vast

quantities of soap and alkali were used in its removal from the wool. Lanoline fat is of a very peculiar nature. During the period when Alderman Robert Pratt was Chairman of the Committee, a great deal of work was done to reach an understanding of the problem which had to be dealt with. Elaborate analyses of the sewage were made by Mr. F. W. Richardson, F.I.C., the Borough Analyst, and following upon these analyses, the properties of lanoline were carefully investigated by Professor Dewar (now Sir John Dewar), and at the request of the Corporation, Professor Dewar made experiments which resulted in his discovering that the lanoline fat, being of very nearly the same specific gravity as water, would not rise to the surface as ordinary fats might do, and could not be skimmed off. It remained in suspension in extremely minute globules. Professor Dewar found further that it had a peculiar property of adhesiveness to water—as he called it—which retarded the extraction of the water from the sewage sludge, so that even after prolonged precipitation the sludge contained 98 per cent. of water as compared with 90 per cent. in the sludge of ordinary town sewage. This state of dilution increased five times the amount of sludge to be dealt with, and made the production of a satisfactory sludge-cake very difficult.

One more difficulty arose from the presence in Bradford of many dyeworks, which also poured their effluents into the sewers, so that the sewage at one time ran acid, at another strongly alkaline.

After many experiments the method adopted

was to precipitate the solids with lime and the effluent then underwent a final purification by filtration through coke-breeze. The works were so operated for many years. Only a portion of the sewage could be dealt with, however, and meanwhile the town was growing rapidly.

Subsequently the use of lime as a precipitant of the sewage was abandoned, and ferric sulphate was used. But this proving very expensive, sulphuric acid was substituted in January, 1901, and treatment by this chemical has been continued to the present time. After precipitation difficulties were conquered, it became necessary to dispose of the sludge, and experiments proved that this could be effected by means of filter presses. Through this treatment the grease is extracted and is marketable, as is also the dried sludge-cake. Since 1903 this process has been gradually expanded.

The condition of the Aire improved but slowly under the early experiments, and the West Riding of Yorkshire Rivers Board, which was formed in 1893, almost immediately brought pressure to bear on the Bradford Corporation to improve its effluent. The Corporation accordingly decided in 1894 to extend the Frizinghall works, and the consent of the Local Government Board was given to the scheme with the express intimation that it was accepted "very reluctantly," the Board evidently feeling that though it was the best devisable, any scheme of treatment in so limited an area—some fifty acres—as was at the utmost available at



Frizinghall was necessarily far from satisfactory. Beck and road improvements were carried out, but before the purification works at Frizinghall were commenced the scheme for the extension of the boundaries of the borough arose. In the course of the Local Government Board's enquiry into that proposal the sewage disposal of Bradford was a good deal criticised, and eventually, when the extension was sanctioned, there was appended a stipulation that Bradford should proceed with a proper sewage disposal scheme within six months. By this extension an area of 12,067 acres was added to the borough, making the total 22,843 acres, of which 18,400 acres drain towards the Aire Valley and the rest towards the Calder.

### The Esholt Scheme Conceived.

Meanwhile the feeling was growing that it was necessary to remove the works to the main Valley of the Aire, and the only site there available seemed to be at Esholt on the estate of the successors of the gentleman whose legal proceedings first emphasised the gravity of the problem. Before proceeding with an undertaking of such magnitude as the acquisition of the Esholt estate an alternative policy was tried by the Committee, of which at that time Alderman Robert Pratt was Chairman, and Councillor (now Alderman) Richard Johnson was Deputy Chairman. It was agreed that as the complexity of the problem and the costliness of treatment arose from the greasy "suds" from the woolcombing works, these should be dealt with separately. Two

alternatives were suggested. One was that trade effluents should be removed to Valley Road by a separate system of sewers, or alternatively powers should be obtained to compel woolcombers to remove the grease from the effluent before it passed from their own works.

This was embodied in a Bill promoted in Parliament in 1897. Parliament, however, refused the construction of a separate system of sewerage, and only allowed the woolcombers to be dealt with on certain lines. Many woolcombers had, it was held, acquired a prescriptive right to use the sewers for the disposal of their effluent. Power was given to compel them to deal with their own sewage on certain heavy payments to them by the Corporation—£18 per machine woolcomb in use—but they were only required to use the “best practicable method,” and they could only be coerced if they had adequate land for the construction of works. As many of the woolcombers had little or no land available, it was evident that a certain amount of fatty matter would still go into the sewers, and would have to be dealt with before any land or bacterial treatment could be adopted. The policy of separate treatment for the woolcombers’ suds has consequently not been pursued.

### Parliamentary Troubles.

The Corporation were thus driven to the scheme for removing their works to Esholt, and the proceedings reveal almost at their worst our national machinery for controlling the operations of local bodies.



In 1898 the Corporation decided to apply for the Esholt site. Negotiations to that end with the owners were unavailing, and the Corporation in the next session went to Parliament for compulsory powers. It was proposed to acquire the whole estate, it being felt that this course was more fair to the owners than the acquisition of a part only, while it also obviated claims for deterioration and separation of lands. After an inquiry in which the owners of the estate—the Misses Stansfield—opposed any sale whatever, and maintained that the Frizinghall site could be made adequate, the Local Government Board came to the conclusion that Frizinghall was unsuitable for sewage works, and they granted a Provisional Order empowering the Corporation to purchase—not the whole estate asked for—but 529 acres, including Esholt Hall. The Provisional Order was opposed by the Misses Stansfield, and the Local Government Board intimated to the Bradford Corporation that they left it to the Corporation to support the Order. This the Corporation did, and after a long and costly fight in the session of 1899 a Select Committee of the House of Commons refused to confirm the Provisional Order, no reason being given.

This decision did not, however, remove the compulsion which Parliament had previously confirmed that a complete sewage scheme should be proceeded with, and continued negotiations with the owners of Esholt having no effect, the Corporation were compelled to go to Parliament again in 1901. They asked now for power to acquire 814 acres in

the Aire valley, of which 685 acres were the property of the Misses Stansfield. The Bill came first before a Select Committee of the House of Commons. The Committee decided that the Frizinghall site was inadequate, and the chairman took a map of the Esholt district and traced an area of land which the Committee considered should be used. This was found to contain 310 acres, of which 201 were on the Esholt estate. The Bill thus modified passed to the House of Lords, but a Committee of that House decided that the area allowed by the House of Commons Committee was insufficient, and they threw out the scheme altogether.

### **The Purchase of Esholt.**

In 1902 the Corporation, being still pressed by the Rivers Board, approached the Misses Stansfield again. Protracted negotiations ensued, and as they seemed hopeless it was resolved in 1903 to ask Parliament to change its mind once more, but in February 1904, the owners came forward with an offer to sell the whole of the Esholt estate to the Corporation. The Corporation eagerly seized the opportunity, and compulsory powers were subsequently obtained, without opposition, for the purchase of some subsidiary areas of lands. The price paid to the Misses Stansfield was decided by arbitration, and on February 2nd, 1906, the purchase price, £239,742, was handed over, and the estate became the property of the Corporation.

A detailed scheme for the utilisation of the estate was submitted to the Council by the then Chairma



will be two, with a total capacity of one million gallons. A short sedimentation will suffice to remove from the sewage much heavy matter, such as road-grit, stones, and rags, and provision is made for the clearing of the tanks day by day by means of a bucket-dredge. Freed of its heaviest materials the sewage will next be screened through a number of automatic self-cleaning machines designed especially to deal with sewage containing a quantity of wool.

### Storm Waters.

At the detritus tanks will be placed the storm-water overflows. The street surface water drains of the city are conducted into the general sewers, so that special provision has to be made for dealing with the enormous volume of water brought down in time of storm. Any excess volume of sewage over 30,000,000 gallons per day will be dealt with by simple settlement in special tanks, of which there are seven with a total capacity of about 11,500,000 gallons. From these tanks the storm water will discharge direct to the river.

In normal times the whole of the sewage, and in storm times as much as 30,000,000 gallons a day, will be treated by chemicals and passed into the precipitation tanks. To reach these the sewage will be conveyed across the valley by means of a high level aqueduct. The precipitation tanks will be divided into two series, each consisting of twenty tanks, and the whole will have a covering area of



thirteen and a half acres. Here the sludge will be deposited, and the clear tank effluent water will pass over weirs into the effluent channel. It will then be conveyed, by means of two conduits contouring the valley—one in the direction of Baildon and the other in the direction of Apperley Bridge—either to artificial filters or to land irrigation areas, where the final purification of the effluent will be carried out.

For land filtration 200 acres of land near the river will be used for intermittent treatment, and in addition 200 acres of heavier land on the hill side will be available for surface irrigation. To complete the filtration the scheme included an area of sixty acres of artificial filters, estimated to cost nearly £500,000. This portion of the scheme the Local Government Board have allowed the Corporation to defer until the results of experiments now being carried out on thirty acres of land adjoining the river have been ascertained.

### The Treatment of the Sludge.

The precipitation tanks will be operated to yield a sludge containing about 80 per cent. of water. This sludge will be discharged to an underground reservoir at Strangford. At the present time (1912) pending the construction of the tunnel outfall sewer from Frizinghall to Strangford, the sludge produced at the existing Works at Frizinghall is conveyed by means of a steel pipe along the Canal Towing Path to this underground reservoir. From this reservoir the sludge is lifted by means of two 30-ton

vessels operated by compressed air, and is carried into the sludge disposal buildings, which have been erected close to the reservoir. Here the sludge is passed into two steel vessels provided with silent steam heaters which raise the temperature of the material nearly to the boiling point of water. By this means the grease is rendered liquid and the separation of both grease and water from the solid matter is facilitated. To effect this extraction the sludge is carried forward from the heaters into another series of closed vessels from which by means of compressed air it is forced into filter presses.

The solid matter remaining in the filter presses constitutes an excellent manure for agricultural purposes. It may be discharged in the cake form direct to railway waggons, or it may be completely dried and disintegrated for those merchants who prefer the material in the form of a fine powder. Provision is made for the storage of the dried material to await marketing.

### Recovery of the Grease.

The liquid from the filter presses, consisting of grease and water, is conveyed into a large cast-iron separating vat. Here the grease accumulates on the surface, and is constantly run off and pumped into the grease purifying vats established in the grease-house. The water from the separator is taken from a point near the bottom of the tank, and is pumped back into the crude sewage.



The final process is the purification of the grease. This is effected in sixteen vats of steel lined with heavy sheet lead. Here the grease is boiled up with sulphuric acid and any other chemicals which may be thought necessary, the action being directed to remove the water and impurities contained in the grease. After the refinement has been concluded the vats are allowed to stand for twenty-four hours. The grease is then in a marketable condition, and is delivered packed in barrels or in tank-wagons provided by customers.

### **The New Buildings.**

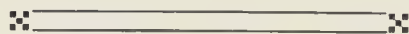
To deal with the sludge from the precipitation tanks buildings have been erected and machinery installed. The buildings comprise engine house, boiler house, a press-house for 128 filter presses, and a grease house, together with a branch siding connected with the main line of the Midland Railway, and a canal-basin connected with the Leeds and Liverpool Canal. A messroom and works for the manufacture of the Sulphuric Acid used in precipitation of the sewage have yet to be constructed.

On September 20th, 1910, the then Lord Mayor of Bradford (the late Alderman William Land, J.P.), opened the new railway siding, and laid the foundation stone of the Sludge Disposal Works. On September 15th, 1911, the succeeding Lord Mayor of Bradford (Councillor Jacob Moser, J.P.) put a keybrick in the subway beneath the canal at Esholt, which is designed to convey (in pipes) the storm-

water, after it has passed through the detritus-tanks, to the river. On March 30th, 1912, Mrs. Garfield, wife of the City Sewage Engineer, started the first press in the new house.

The designing of the new works has been the task of Mr. Joseph Garfield, Assoc.M.Inst.C.E., who was appointed in 1899, as Sewage Works Engineer to the Corporation. Mr. James Watson, M. Inst.C.E., the City Waterworks Engineer, was by resolution of the City Council, in March, 1912, associated with Mr. Garfield as joint engineer for the construction of the tunnel outfall sewer and valley crossing. Mr. Howard Wontner Smith, Assoc. M.Inst.C.E., was, in 1903, appointed Chief Assistant Engineer, and in 1909 Resident Engineer of the Works.

The sewage of the Urban District of Yeadon will also be dealt with at the Esholt Works, the Corporation having entered into an agreement to treat the Yeadon sewage for a period of thirty years.



### *THE FIRST SECTION OPENED.*

The first section of the works at Esholt was formally opened by the Lord Mayor of Bradford (Alderman J. B. Moorhouse, J.P.), on Tuesday, September 24th, in the presence of a large gathering, among those present besides the Chairman (Alderman Richard Johnson, J.P.), the Deputy Chairman (Councillor John Garnett), and members

of the Sewage Committee, being many other members of the City Council, the Leeds City Council, and other local authorities.

At the entrance to the sludge disposal works the Lord Mayor briefly addressed the gathering; he declared the works open and expressed the hope that they would successfully serve the purposes for which they were designed. The party then passed through the engine house into the press house where with brief ceremony the Lady Mayoress (Miss Moorhouse) started the one hundredth filter-press installed there. Since the first press was started by Mrs. Garfield, on March 30th, sixty-six had been moved in from the old works at Frizinghall, and new ones had been added to the equipment.

Alderman Johnson stated that in a short time he hoped to see 128 presses at work in the department, and as, he remarked, "they all make a profit, some of us wish we could usefully install a thousand of them."

The party next assembled in the engine-house where two steam engine air-compressors were started and named by Miss Mary Johnson, daughter of Alderman Johnson, and Miss Verena Garnett, daughter of Councillor Garnett. This duty discharged, Mr. W. T. Bell, the Managing Director of Messrs. Robey & Co., of Lincoln, the builders of the engines, presented each of the two ladies with a brooch, as a souvenir of the occasion. Each of the engines is of 200 horse-power and is capable of compressing 700 cubic feet of air per minute up

to a pressure of 100 lbs. to the square inch. Each is of sufficient power to work the full complement of presses.

The ceremony concluded with expressions of thanks. Mr. Alexander W. Wylie, Managing Director of John Wilson & Sons (Johnstone) Ltd., of Vulcan Works, Johnstone, N.B., who supplied 36 of the presses, presented the Lady Mayoress with a gold watch-bracelet, and moved a vote of thanks to the Lord Mayor which was carried with acclamation.

The Lord Mayor, in responding to the vote, said that the Bradford City Council had thought it advisable to put in hand the portion of the scheme which would most quickly effect an improvement in the condition of the River Aire, and it was this portion which had been inaugurated that day. The expenditure entailed by the scheme had been heavy ; up to that day some £400,000 had been spent, nearly three-quarters of which was for land and the rest for works. There still remained to be carried out the main outfall sewer in tunnel from Frizinghall—the valley crossing,—additional detritus, precipitation, and storm water tanks—the preparation of land for filtration,—and artificial filters. To carry out these portions of the scheme would entail more than double the expenditure which had already been incurred. The particular feature of the Bradford works would be the filtration area, consisting of a level stretch of sandy soil over which the sewage was distributed by appliances such as were usually used in connection with artificial filtration works only. The sludge disposal



works were also peculiar to Bradford, and were designed on a scale to suggest a population of 3,000,000, whereas the actual population of the City was only one-tenth of that number. The explanation of this fact was seen in the nature of the industries of the town. There were, for instance, individual mills which discharged sewage equal in amount to that of a small town. On the other hand the Bradford Corporation were in the unique position of being able to obtain a considerable revenue from the sludge disposal works. He was told that the press which the Lady Mayoress had started that day would continue to extract from the sludge it treated grease to the value of 20/- to 30/- a day, seven days a week, and would continue until it was scrapped in its old age. How long that would be he did not know but other presses had been doing similar work for the last ten years.

The Rev. Sir Piele Thompson, Bart., moved a vote of thanks to Alderman Johnson and the Sewage Committee, and in doing so gave some interesting reminiscences of the district in the past.

Mr. Thompson Marshall, of Yeadon, seconded the resolution. He said that Yeadon had fought Bradford year by year for the right to deal with their own sewage disposal problems, but the Local Government Board had given them to understand that they would not have little sewage disposal works dotted all over the country, and as Bradford was carrying out its huge scheme so near them, the Local Government Board advised Yeadon to make terms with their big neighbour. So Yeadon had

entered into a thirty years' contract without provision for bonus or profit. But Yeadon felt that the arrangement would on the whole be for the benefit of the district.

The resolution was agreed to.

Alderman Johnson, in acknowledging the compliment, said that Yeadon had set an example which might well be followed by other local authorities—those of Guiseley, Bingley, and Shipley, for instance—and they had made a good bargain for themselves. Bradford was ready to do the work at cost price. The Bradford Corporation believed that the country-side ought not to be disfigured by a large number of small sewage works, but that sewage disposal ought to be concentrated as far as possible at large centres like that at Esholt.

The next task before the Corporation, Alderman Johnson went on to say, was to make the tunnel from Frizinghall. The contract for this work would be let very shortly, and he assured the members of the Rivers Board that within a few months great progress would have been made. Bradford had never shrunk from its duties and responsibilities ; it had only striven to be sure that the ground upon which it proposed to travel was safe and sound. Ratepayers ought not to have imposed upon them a burden greater than they could bear. He desired to tell the representatives of townships lower down the River Aire that Bradford, through the works which were being opened, was practically taking out of the river the equivalent of 10,000 tons of sludge per week.

The proceedings then terminated.

## AN HISTORIC ESTATE.

The estate of Esholt possesses no little historic interest. The name of the place implies "Ash-wood," and that name in itself curiously links the past with the present. Ash trees are not very common upon the Coal Measure rocks which prevail in Mid-Airedale. The native woodland, the primæval jungle which clothed the hillsides of Aire and its tributaries before man cut into them a multitude of "royds," was of oak. Ash trees flourish only upon soil well supplied with lime, and if ashes were in this little bend of the Aire valley so numerous as to attract the special notice of the early settlers, we may find the reason in the circumstance that in the Great Ice Age a glacier from the mountains at the head of Airedale brought down from the Craven crags by Settle abundant limestone debris. In the river valley itself few limestone boulders remain. For centuries they were collected and burnt for lime for building and for the fertilisation of peaty land, but in the Boulder Clay which lies up on the northern flank tracing the line of the lateral moraine of the glacier, there is still much limestone, and ash trees find the conditions suitable, so that the Esholt woods have many fine specimens.

Esholt is not mentioned by name in that first and greatest of national records, Domesday Book, the taxing assessment made by William the Conqueror's orders in 1086. But there were in the

wide manor of Otley two different subordinate manors (berewicks) both called "Hawksworth." One of these, it is fairly evident, must have been really Esholt. But Domesday tells us much of interest relative to the locality. The estate which the Bradford Corporation now own extends far beyond the border of the township of Esholt into Hawksworth (proper), Guiseley, Yeadon, Baildon, and Rawdon. All those places—except Rawdon—lay in the lordship of the Archbishop of York, and their dues had before the Conquest contributed to the upkeep of the splendour and the civilising influence of the Northumbrian see. But at the dread coming of William the Conqueror to wreak vengeance upon the inhabitants of this hill-country for their fierce opposition to his arms the district had been utterly devastated. In the eighteen years which had elapsed between William's awful campaign in Yorkshire and the Domesday survey, a few poor farmers and their labourers had crept back to their ruined homesteads and had rebuilt them, but most of the locality still lay desolate. It was indeed the very limit of cultivation, for the Sheriff of Yorkshire did not, when the survey was drawn up, discover a living soul from Bradford to the mountains.

Rawdon had perhaps even more interesting ownership than that of the Archbishop, for it was the property of Robert Bruce—to adopt the modern spelling—the ancestor of his famous namesake, the unfortunate King of Scotland, whose constancy in a struggle against a sea of troubles has been the admiration of ages. It is curious to link up great romantic



figures like the Bruces with this busy industrial district, and to look upon them as a Yorkshire family. But so they were before Scotland knew them, for they had their castle at Skelton, to the north of Whitby, and the old priory at Guisborough which they founded, and the abbeyes of St. Mary at York and Whitby, to the riches of which they largely contributed, testify to their local patriotism and devotion. Airedale must, consequently, have shared with Cleveland in a curious interest in the scraps of news which came through of the great doings in Scotland in the early fourteenth century.

Esholt itself comes into history under that name in 1172, when Sir Simon Warde, of Guiseley, gave some of his land beside the Aire to the Syningthwaite Priory, a little Cistercian nunnery which had been founded a dozen years or so earlier in the fertile plain between Wetherby and York. The Wardes seem to have been a family of some interest, but in early days of no great wealth locally, but they were good friends to the Cistercians, then establishing their hold of the Yorkshire dales. They gave many gifts to Fountains Abbey, and some to Kirkstall Abbey.

### A Cistercian Nunnery.

How long the Syningthwaite nuns retained their Esholt interest and how they lost it no one knows, but just before Richard I.—“ Richard Yea and Nay ”—commenced his erratic course through Europe a nunnery at Esholt is found in existence. One Galfred Haget, of whom there is nothing to say,

and the Wardes were honoured as founders. The early interest of the latter family was continued thenceforth. As successive generations of Wardes grew in wealth they gave rich gifts to the little nunnery, and several members of the family directed that they should be buried there, and one at least of the prioresses bore the name of Warde.

After its establishment the little convent enjoyed for three and a half centuries the happiness which is asserted to belong to the community without history. Nearly all we know of its affairs consists of the names of a few of those who proved themselves benefactors, and a hardly less imperfect list of the prioresses who ruled within the walls of the little establishment. The stirring events of the times passed this little retreat by. But some ripples must have been raised in the pool in passing. The place was the refuge for, among the others, the daughters of a good many of the important local families—the Wardes, Calverleys, Chellerys, Woodhalls, Pudseys, Plumptions—and austere as was the Cistercian rule the nuns cannot have gone unmoved when brothers and cousins lost their estates in the Magna Charta campaign of the Barons against King John—as did the Wardes temporarily—or were captured or fell fighting at Bannockburn or Flodden.

The Cistercians were no literary order. They wrote no chronicles, and took no care to transcribe and preserve the ancient classics. But they were splendid farmers, and their great abbeys of Fountains, Kirkstall, and Rievaulx, gave to Yorkshire farming a tone which it has never lost. The nuns of Esholt

took their share in this agricultural work as supervisors and directors of their retinue of servants, and among the few documents which have survived is a bundle of farmers' and foresters' accounts in the Public Record Office, which shows with how much care—a care excelling that of most modern farmers—the bailiffs accounted for their receipts and payments and the foresters recorded the dates of their various plantings. There is some hint, however, that Esholt suffered the decay which overcame monasticism generally in the fifteenth century. It probably had at the height of its prosperity eighteen nuns—that being the number of the nuns' stalls in the church—but it had only six when Henry VIII.'s commissioners travelled here to demand and receive the surrender of the little community of their home and property, and to dissolve the house.

We get a glimpse of the convent as it stood in its latter days through a description made by a surveyor of the Exchequer immediately after the Suppression. The writer was interested only in recording the saleable building materials—lead, timber, stone, and slate. He cared nothing for archæology, and it was somebody else's business to take account of the plate, valuable reliquaries, and so forth, so that the description does not answer all the questions one would like to have settled. But through all the confusion of this description we get hints which enable us to form a pretty clear conception of the little house. Let us start with its situation :—

“Item the seid monastery is sett vpon a Ryuer callid Heyer. And she is lady of the same water vpon bothe sydes, that is to sey by the space of iij quarters of a myle vpon the north syde and half a myle vpon the southe syde. And ther is ouer that Ryuer a ffayre brigge, which the lady must maynteyn in reparacon.

“Item she may fishe in the seid Ryuer at her pleasure from the lorship of West Essholt vnto Apperley Brigge, which is by the space of half a myle or more.”

### The Convent Buildings.

The conventual buildings themselves evidently followed generally the ordinary Cistercian plan, but the smallness of the house involved a reduction of the number of apartments usual in larger houses like Kirkstall. The church was quite small, being but seventy-two feet long and eighteen feet broad. It was divided into two equal parts by a rood loft. The choir contained eighteen stalls for the nuns, and the nave beyond the rood, which was allotted to the servants of the convent, was also provided with seats, a somewhat rare furnishing. The window above the High Altar was of three lights with “viij other partes of glass aboue”—from which we may infer that it was of Geometrical or Decorated design. This may possibly indicate the rebuilding of the choir in the fourteenth century, since the other windows of the choir were also of three lights each. The nave was lighted only by six little windows each two feet in height and half a foot broad—pro-



portions which suggest the Early English style, so that the nave probably belonged to the original building. We are not told whether the church had aisles—possibly not—nor whether it had transepts, which is probable. Upon the church was a “stepulle of litle thack bordes couer’yd with slate.” This must have been a bell turret such as was once common, but to find an existing example of which we must go to Hubberholme Church in Wharfedale.

From the church one passes to the cloister, in the eastern walk of which was the chapter house—the business council chamber of the little community. This was a room fifteen feet square. Next to it was a little chamber the purpose of which is not known, though in some big abbeys it is supposed to have been used as a mortuary-chapel. Then came a passage-way to the eastward. This led out into the orchard, for there was not at Esholt such a suite of infirmary buildings as occupies the ground eastward of the cloister court of Kirkstall and Fountains. These two apartments and passage being all that touched the eastern wing of the cloister, there must have been plenty of room for the existence of a south transept.

Over this eastern range of rooms was, of course, the dormitory of the nuns, which was fifteen feet broad, and forty feet long. It did not retain its primitive simplicity, but had been divided into seven cells. At the south end of the dormer were three little rooms “callid the ladyes parlors.” Two of these rooms had fireplaces and all had windows

looking across the river to the wooded hills of Idle and Thackley,—a very fair prospect. One of the parlours had a “litle kychyn,” so that this may have been used for the eating of flesh meat on the occasions when, through ill-health, a nun was permitted to add to her diet meat, a luxury not admitted to the monastic kitchen proper. These comfortable apartments would obviously belong to a period when the austerity of the rule was becoming a little relaxed, and they would undoubtedly utilise the space saved in the dormitory when the number of nuns was reduced.

In the south walk of the cloister, and at the eastern corner was the door of the great parlour—the one room in the building which in early severe days had a fire in the winter, and in which was relaxed the rule of absolute silence prevailing elsewhere. This room had a “ffayr chimney of stone” six feet wide. Looking into the orchard was a bay-window “glasid.” Next in the south aisle was the refectory—the “hall” as it is called here—a building of thirty-five feet by twenty feet. This stood with its long axis north and south—as at Fountains and Rievaulx. On the west side towards the north end was a “fayre bay window” with an upright window above it. Within this bay window doubtless stood the pulpit from which during meals a book was read to the diners, according to the custom of the Order. The bay window may be compared with those at Rievaulx and Fountains. On the opposite side of the room was a large wood and plaster fireplace.

The pantry and buttery seem to have been at the south end of this hall with the customary screens fitted with two sliding doors and one "shutting door." Close by was a "kychyn of the olde ffasshyon" with a louvre roof. Those who have seen the kitchen of Glastonbury Abbey will recognise the "old fashion,"—the custom of the Benedictines—for the position of the kitchen usual with the Cistercians—adjoining the south walk of the cloister—was at Esholt impossible because of the smallness of the cloister court. In this detached kitchen which may have been octagonal, was a fire-range twelve feet in width—very ample proportions—and two "fair ovens," in one of which could be baked two stones of bread, and in the other one stone. Adjoining the south end of the "hall" was a pantry (for the bread), a buttery (for the drink), a larder, a malt-house, and a brew-house.

There was also an "old hall" occupied in the latter days of the convent, by a man and his wife who were in effect lodgers, the right of food and lodging having been conferred upon them either by the patron of the house, or by the nuns as a benevolence or for payment. To purchase of a convent such a "corrody," as that right was called, was a favourite way of providing a refuge for old age.

On the west side of the cloister were a wood-house, a coal-house, a garner, and three "fair chambers,"—probably used as workshops—for the convent was self-supporting in everything, even spinning and weaving its own habit cloths. Over

this range was the dormitory for the servants, who would probably be twice as numerous as the nuns.

Outside this compact little block of buildings was a yard, and beyond it a considerable range of farm-buildings, a lime-kiln, and a mill. There was also a “gate howse over the gate, wherein there ys a prati lodgyng.” The imagination will seek aid in picturing the place from the gatehouse of Kirklees—famous in tradition as the place of the death of Robin Hood—and the comparison will be appropriate, for the Esholt gateway, like that at Kirklees, had a lower storey of stone and the upper storey half-timbered in panels. A good many of the other subsidiary buildings at Esholt were also in this manner of building.

It has been inferred that the place suffered abject poverty, the recorded income in money at the Dissolution being only £35 18s. 11d. a year. But this must have been equal to at least £700 or £800 of the money of our time, and it has to be remembered that nearly all the needs of the place could be met by the products of the farm-lands and the river.

### A Soldier's Home.

After the Dissolution the place lay for some years ruined and deserted. Then the site was granted to one of the officials of the royal court—one Henry Thompson, *gen d'armes* to the King. Thompson had displayed considerable gallantry at the siege of Boulogne in 1544. For this he was rewarded with the confiscated property of an ancient hospital—the



Maison Dieu in Dover. In the last months of the King's life an arrangement was made for an exchange by which the Dover hospital reverted to the Crown and Thompson took the lands of the nunnery at Esholt. Airedale thenceforward became his residence. Possibly for a time his family continued to reside in the monastic buildings. There are in the cellars of the existing hall considerable portions of the outer walls and windows of a building which, though it has been supposed to have been a part of the priory, cannot, judging from the debased character of the architecture, date farther back than about 1600, and this probably formed a part of the Thompson's home.

For about 150 years the estate remained in the ownership of the Thompsons, but it passed through vicissitudes during the ownership of a grandson and namesake of the first grantee. One of his servants drew his sword in a street quarrel in York and struck "one Mr. Blackiston unto the brains, so that he was hardly saved alive." Some sort of "employer's liability" seems to have been proved, and Thompson was ordered to pay £1,000. To evade payment he made his estate over to his father-in-law, Walter Stanhope, of Horsforth, and disappeared into Cumberland, but when in some legal way not quite clear the verdict was set aside, Thompson was "sore put to it to get his estate again from Stanhope, and was not quite loosed till later end of Mr. Calverley's time, after Stanhopes had gotten vast sums out of it." This at least is one gossip's account of the matter.

## The Erection of the Hall.

This Henry Thompson left his estate to an only daughter, Frances, who married Walter Calverley, of Calverley, and it was their son Walter who erected the existing hall. A very interesting Memorandum Book kept by the latter Walter, and now in the British Museum, was edited by Mr. Samuel Margerison some years ago for the Surtees Society. This gives us much interesting material for a picture of the local life of the early eighteenth century. In 1700 Walter's mother—then a widow—made the property over to him, and in 1706, when Walter was thirty-three years of age, he set about building a new hall on the site of the nunnery. The old buildings had been much lower than the existing ground level and had apparently been subject to floods. The level was consequently raised very considerably, a circumstance which would probably account for the fact that so few relics of the nunnery have been turned up in the gardens, and encourages the expectation that considerable remains lie—awaiting some day the spade of the antiquarian excavator—beneath the lawns and shrubberies. It is interesting to notice that Walter Calverley did not engage the services of an architect—a profession then growing into general recognition—but followed the mediæval plan of committing the work of his new house to a “chief mason,” who in this case was one Joseph Pape, of Farnley. The Renaissance style, which was only just then in West Yorkshire

overcoming the traditional debased Gothic, was followed.

In the first week of May, 1706, the foundations of the new house were laid, and a few weeks later Walter, as his note-book shows, "went towards Newcastle" with the task of seeking the hand of Mistress Julia Blackett, the eldest daughter of the late Sir William Blackett, Bart., of Wallington, Northumberland, a wealthy benefactor of the borough of Newcastle. The note-book gives us curious details of the "labyrinth of difficultyes" which beset the matrimonial arrangements, arising partly out of "my lady's [Blackett's] greatness and magnificence," but mainly out of questions of settlement. In the following January the marriage took place, but it was not till September, 1707, that Walter Calverley made entertainment to "all the neighbouring gentlemen and their ladyes" and two days later to "my tenants and neighbours and wives" "upon the account of my wife's coming to Esholt." So that probably that date marks the completion of the house.

Thoresby, the Leeds antiquary and historian, came over to Esholt, or, as it was then called, "New Calverley," in September, 1711, and noted in his diary "the noble and beautiful house lately erected, to which Mr. Walter Calverley is adding gardens and waterworks, etc." Thoresby, of course, searched for relics of the monastery but was too late. "He could hear of none save Elizabeth Pudsey, the last prioress." A stone bearing that lady's name and some insignia still exists and is

built into the wall of the laundry at the back of the hall. Towards the end of that same year 1711, Walter Calverley was made a baronet. For the rest his memoranda are mainly records of hospitality offered at Esholt to the great folk of the time. Ferdinando Lord Fairfax (in the old building), Dr. Richard Richardson, the botanist and antiquary of Bierley Hall, Dr. Sharp, Archbishop of York, the heads of the families of Fawkes, Arthington, Dyneley, Hawkesworth, and others.

The only stirring passage in the history was the visit in disguise of Sir William Blackett—brother of Lady Calverley—in 1715. It was the time of the Jacobite rising, and the incident shows us the difficulties of the times. Sir William was “pursued by Mr. Forster and a great many Northumberland gentlemen who were then in arms against King George”—readers of Sir Walter Besant’s “Dorothy Forster” will remember the part which the Forsters played in this trouble. Their design was to force Sir William to join them, but “he was as much pursued by the King’s forces, who suspected him to be in the rebels’ interest.” “He told me,” says Sir William Calverley, “he was no ways concerned nor under any obligations to them, but was not willing to be taken for fear of being committed to prison.” Calverley too seems to have been suspected of Jacobite tendencies, for on one or two occasions he was pointedly challenged to drink “A confusion to the Pretender, and all his adherents, and to all his open and secret friends,” and on one occasion Esholt Hall was searched by the King’s



officers. It was unsafe ground, and Sir William Blackett was hurried off to security in London in the disguise of a countryman. He tramped across to Wyke, but was so tired when he got there that he bought a horse and took the risk such a possession carried with it.

The Blackett interests in Northumberland, which came by the marriage of Sir Walter into the Calverley family, so greatly exceeded in importance the Aire-dale interest, that the son of the diarist, became wholly a Northumbrian. He adopted his mother's surname and even sold his Yorkshire estates. The Calverley properties, including the ancient home of the family which had been the scene of the terrible happenings of the pseudo-Shakespearian drama "A Yorkshire Tragedy," were sold to Thomas Thornhill, of Fixby, near Huddersfield.

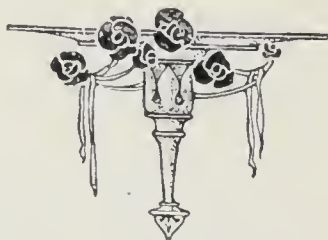
### Purchase by the Stansfields.

For the Esholt estate he found, in 1755, a purchaser in Mr. Robert Stansfield, the youthful son and heir of a then very well known and lately deceased Bradford drysalter, who for some years had been a keen competitor of Sir Walter Calverley in the acquisition of Idle and Thackley properties coming into the market. Robert Stansfield had previously been the owner of the Paper Hall, in High Street, Barkerend, but this he sold upon entering upon the more imposing home at Esholt. He died without issue, and the Esholt estate passed to a sister Anne, wife of William Rookes, of Royds Hall, and from them to a daughter Anna Maria, who married

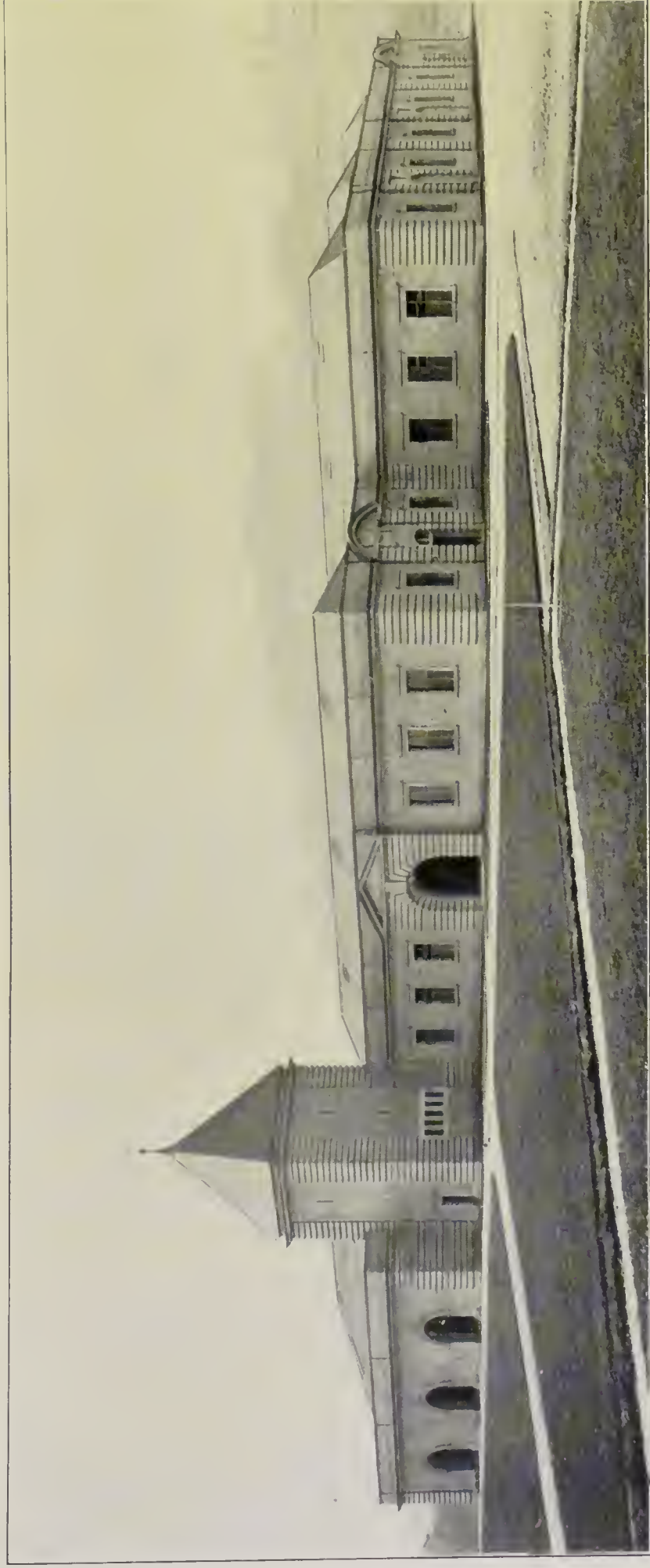
Joshua Crompton, of Derby. Their son, William Rookes Crompton, took the surname of Stansfield, but he had no children and at his death in 1871 it passed to a nephew, General William Henry Crompton Stansfield, whose daughters were the vendors of the estate to the Corporation.

It is rarely that a century-and-a-half of the history of a great landed estate sees so many descents by the female line. The circumstances are peculiarly interesting because of the old superstition, recorded by the antiquary Spelman, that the possessors of the properties of the dissolved monasteries were commonly “cursed” by the failure to continue their family through the male line. It is a superstition which has not sustained statistical examination, but such a line of descent as that shown by the lands of the Esholt nunnery is the sort of case to make the lover of the old fables fancy “there may be something in it after all.” At all events, it may be hoped that the “curse” will not continue to operate in the case of the new owners—the citizens of Bradford.

The fine old oak staircase and the oak panelling “carved by a master hand” which were formerly in the hall are said to be now at Barrowby, Kirkby Overblow.



## SLUDGE DISPOSAL BUILDINGS.



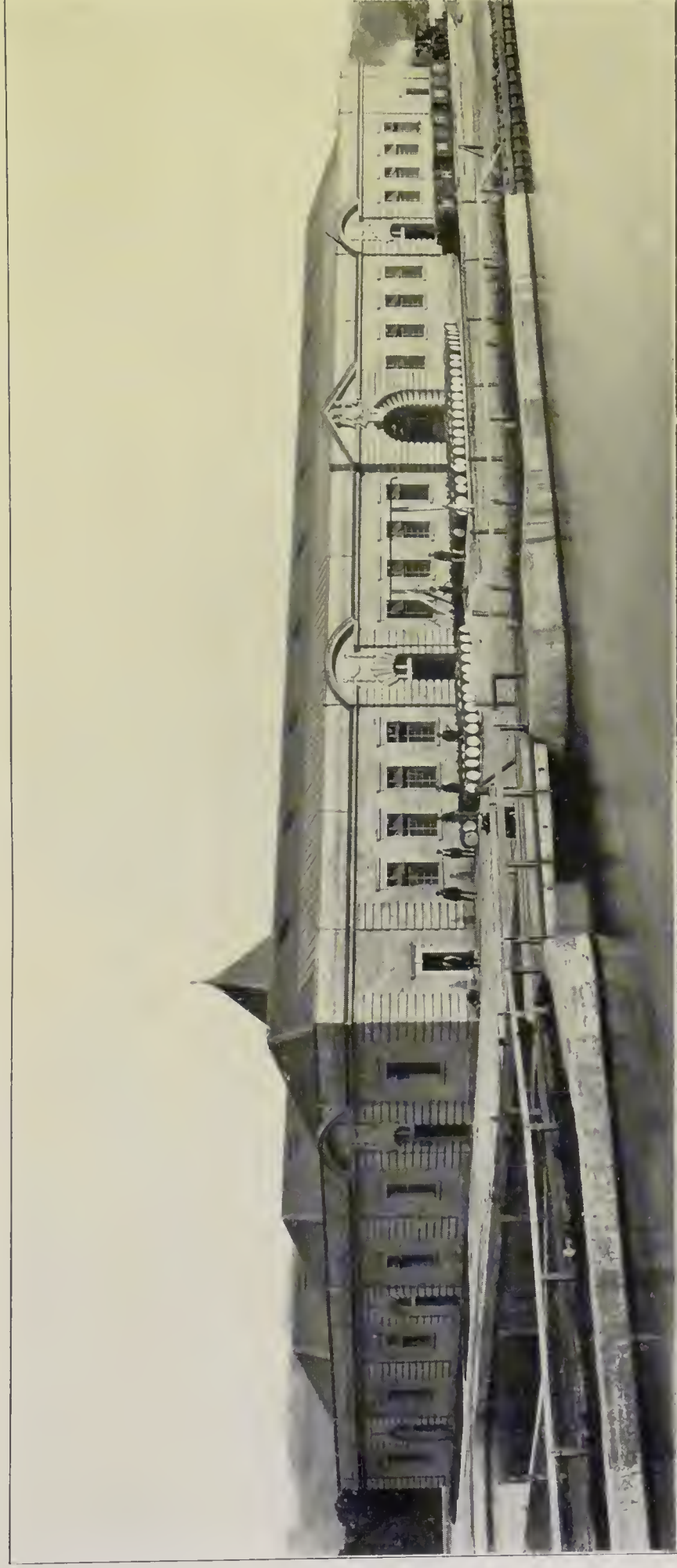
*Photos by Thomas Sykes—Tramways Department, Bradford.*

EAST AND NORTH ELEVATIONS.





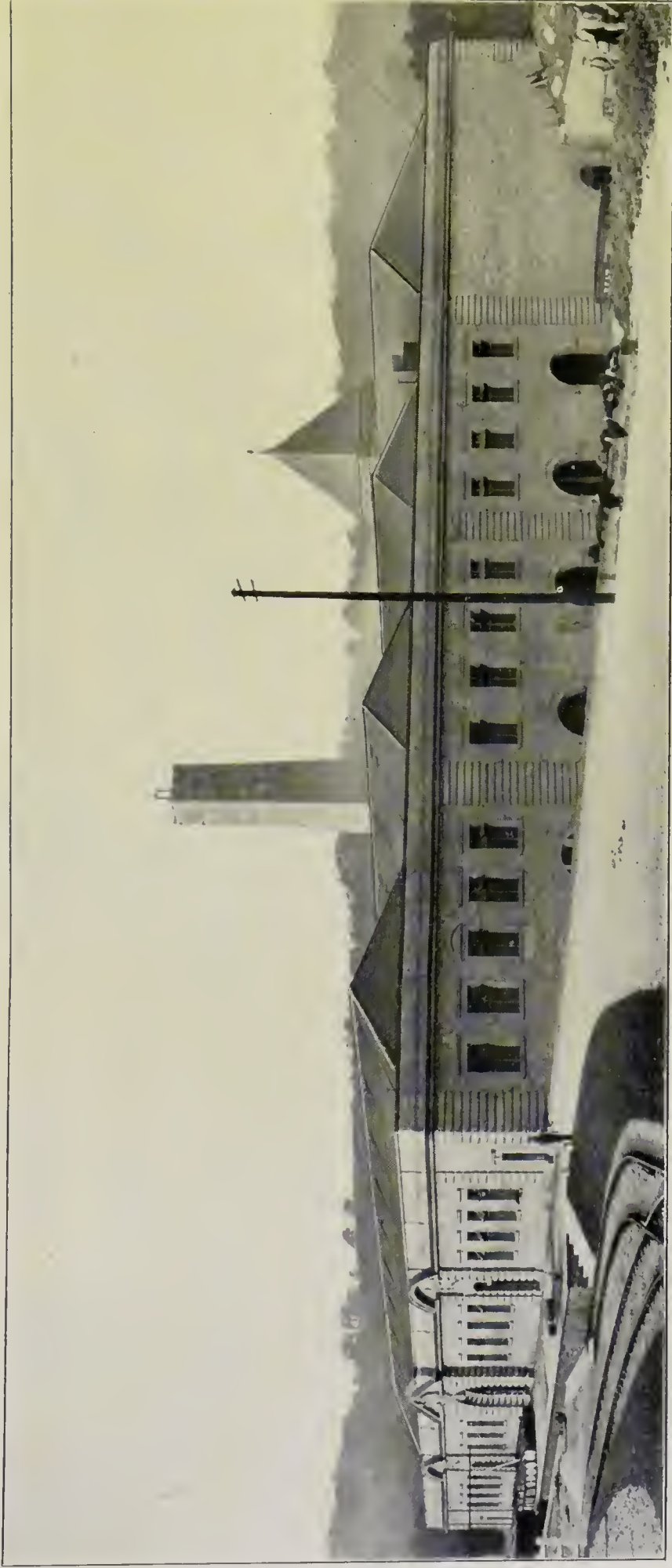
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NORTH AND WEST ELEVATIONS.



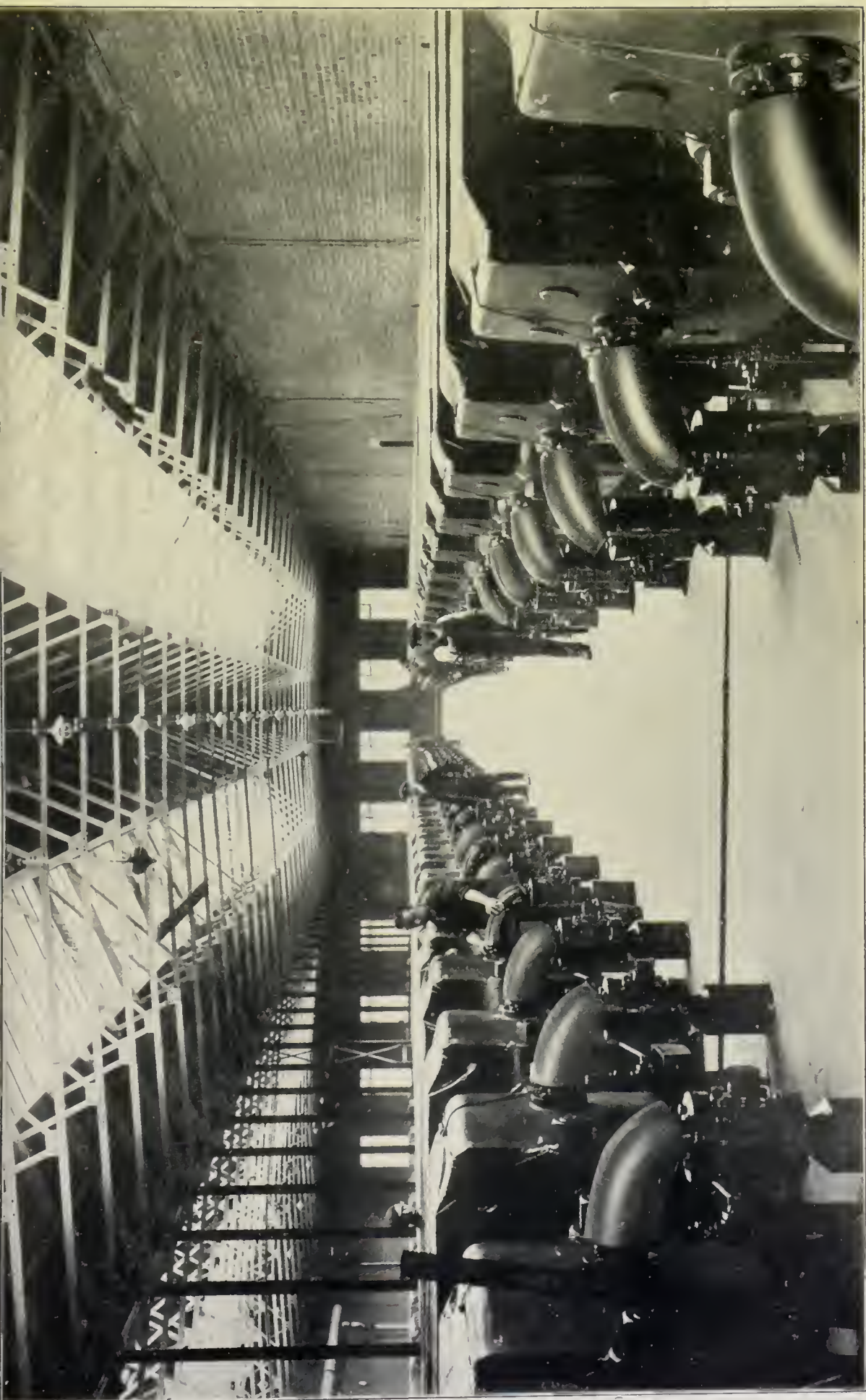
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WEST AND SOUTH ELEVATIONS.



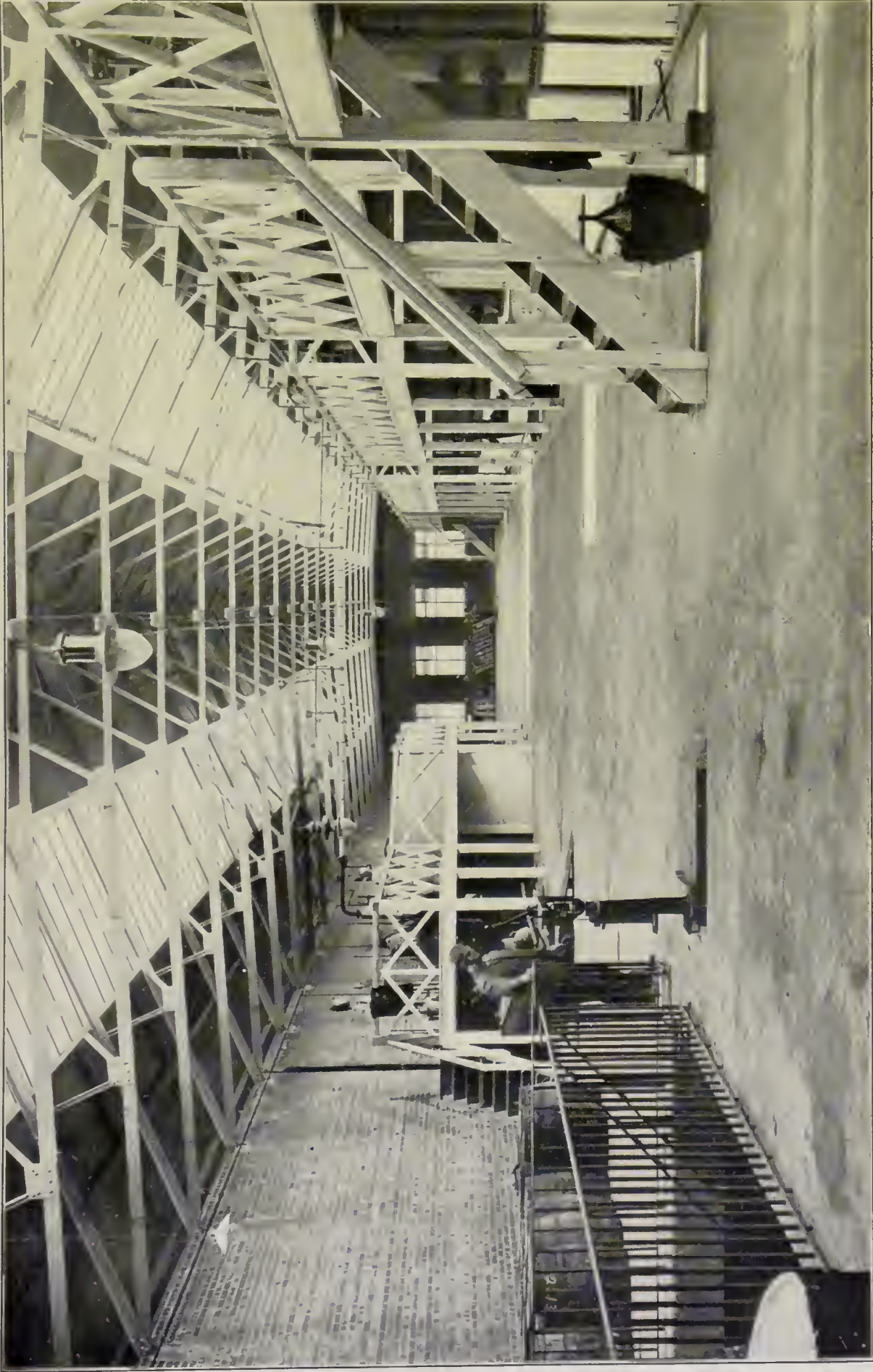




INTERIOR OF PRESS HOUSE.



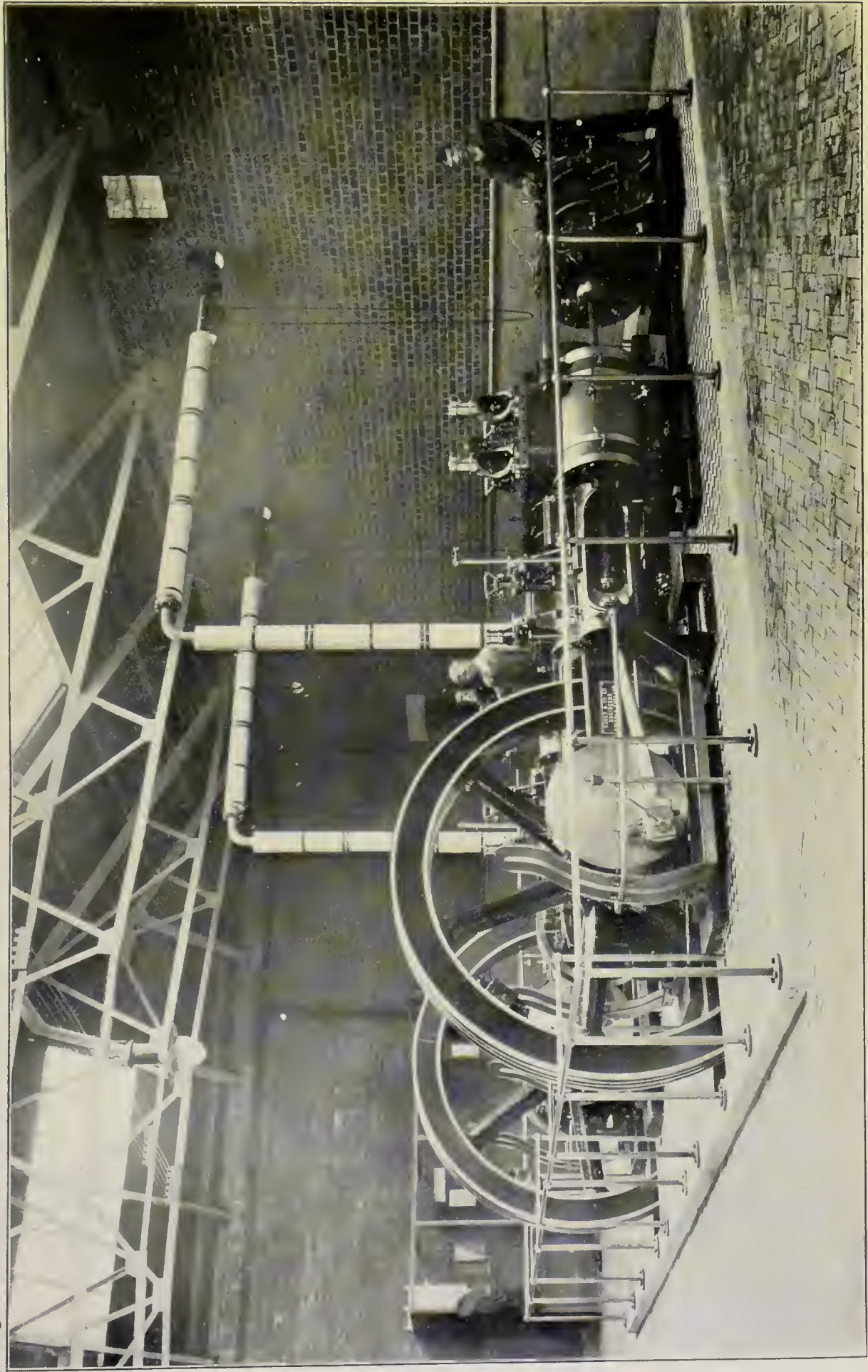




INTERIOR OF GREASE HOUSE.





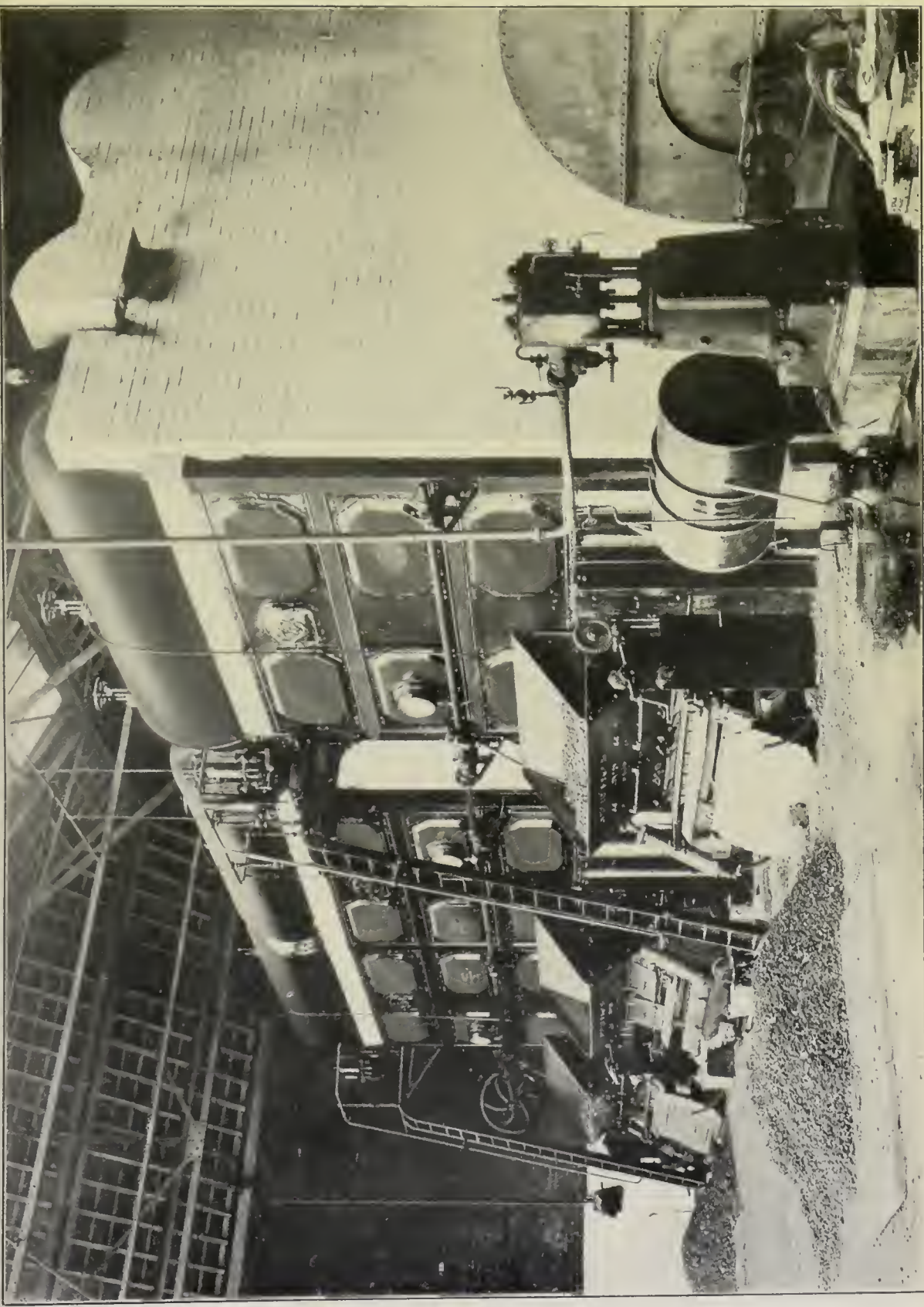


INTERIOR OF ENGINE HOUSE

STEAM ENGINE AIR COMPRESSORS



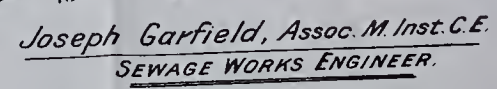




INTERIOR OF BOILER HOUSE.



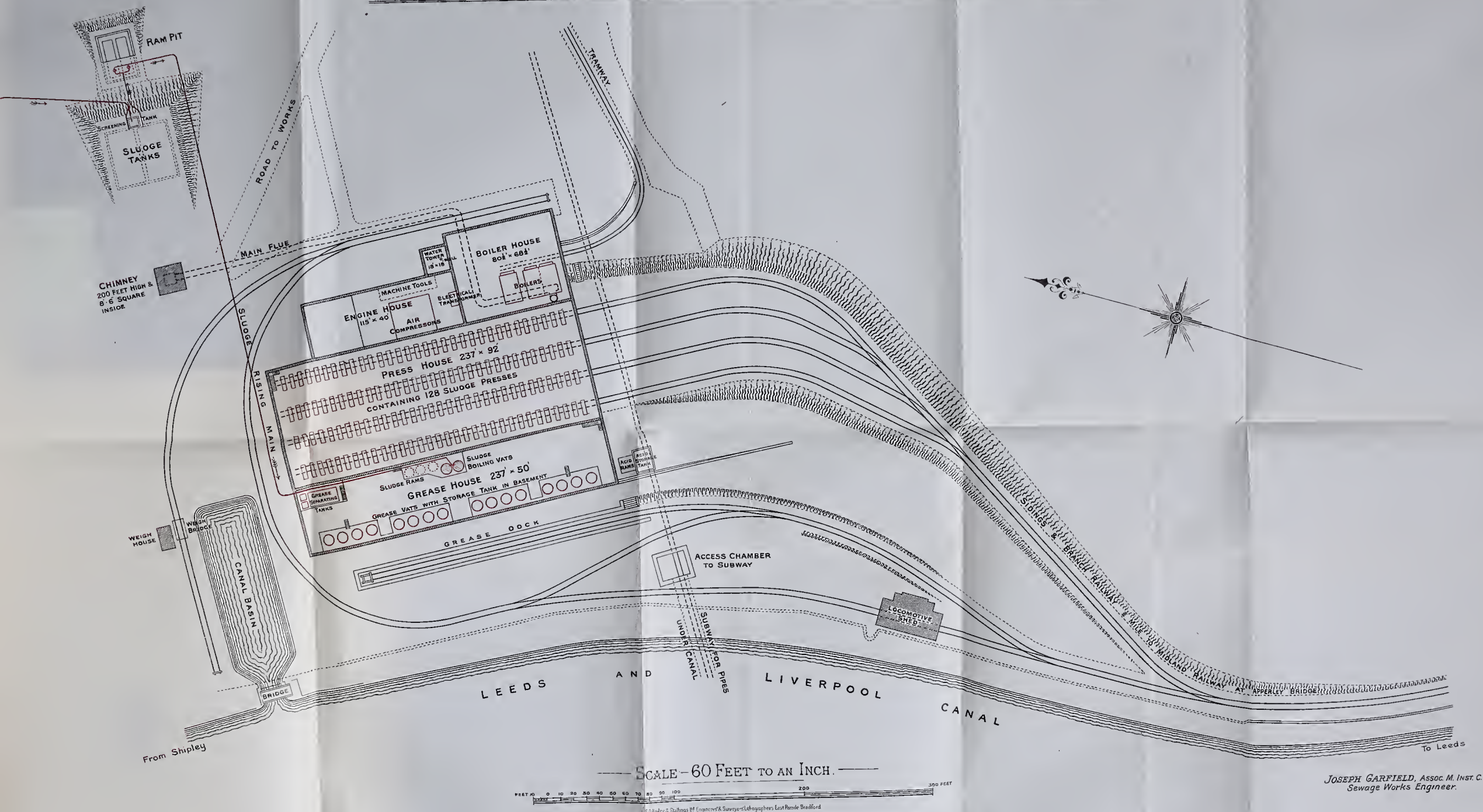








# GENERAL PLAN OF SLUDGE DISPOSAL WORKS



JOSEPH GARFIELD, Assoc. M. Inst. C.E.  
Sewage Works Engineer.







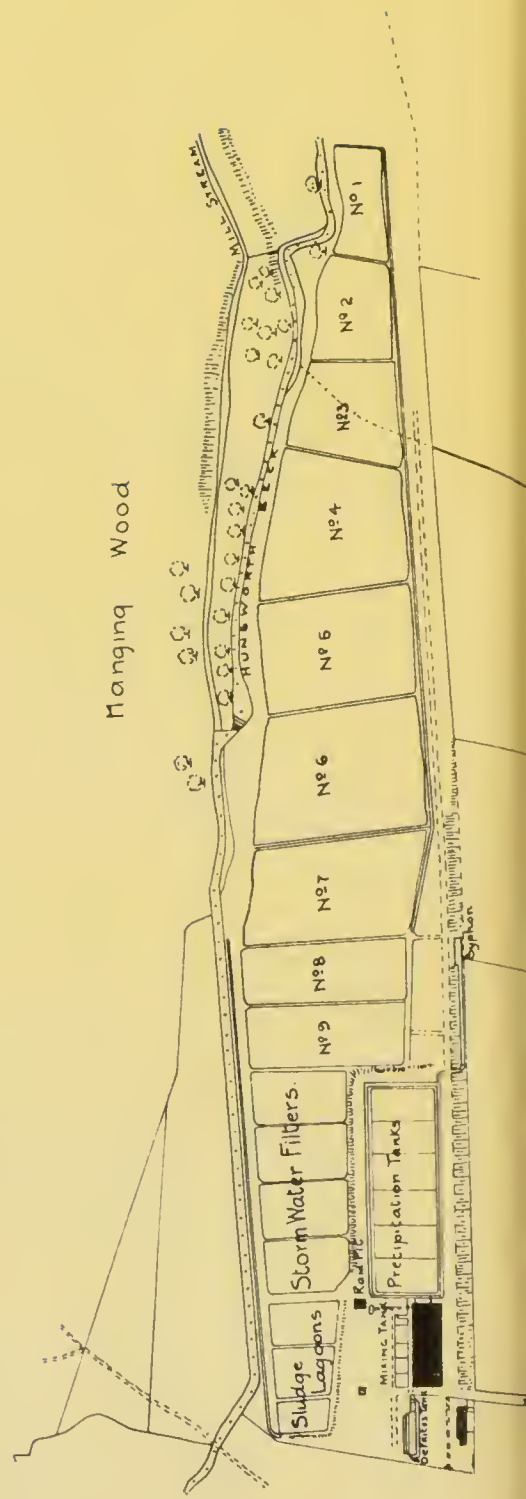
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## RE-CONSTRUCTED 1903.





<b>Areas, &amp;c.</b>	-	-	-	Area drained, about 3500 acres.	Population drained, about 22,000.	Area of works, 22 acres.
<b>Flow of Sewage</b>	-	-	-	Average daily flow, 1,000,000 gallons, about half of which is trade effluent, chiefly dyewater.		
<b>Main Outfall Sewer</b>	-	-	-	3' 0" × 2' 0", egg shaped.		
<b>Detritus Tank</b>	-	-	-	One tank, 60' 0" × 9' 0" × 7' 0".	Capacity, 23,600 gallons.	
<b>Screen</b>	-	-	-	Made by Longwood Engineering Co.	Driven by undershot water wheel.	
<b>Mixing Tank</b>	-	-	-	104' 6" × 21' 6" × 6' 9".	Capacity, 117,000 gallons.	
<b>Septic Tanks</b>	-	-	-	Six open septic tanks, each 45' 0" × 89' 0" × 6' 0".	Total capacity, 900,000 gallons.	
<b>Shed</b>	-	-	-	136' 0" × 45' 0".		
<b>Filters</b>	-	-	-	Nos. 1—9. Total area, 5½ acres.	The filter beds are excavated in clay, and are without masonry walls or floors. The filtering material is shale from the neighbouring coal pits, and is 6 feet in depth. Distribution is by means of spray jets and open grips. No humus tanks have been found necessary.	
<b>Storm Water Filters</b>	-	-	-	Total area, one acre;	3 feet in depth.	
<b>Sludge Drying Lagoons</b>	-	-	-	Area, one acre.		





SEWAGEWORKS ENGINEER'S OFFICE,

BRADFORD.

JOSEPH GARFIELD, M INST CE  
ENGINEER.

LETTERS TO BE ADDRESSED  
TO ESHOLT, NR SHIPLEY.

ENCLOS

12.8.1924.

Dear Dr. Redley:

In reply to your letter I am sending  
you a few details of the Bradford Sewerage and  
works, which I hope will be of use to you.  
I am very glad that you were interested  
in your visit to these works.

Yours very truly,

J. Alexander Reddie







SKETCH PLAN  
— OF THE —  
BRADFORD CORPORATION ESHOLT SEWAGE  
— DISPOSAL SCHEME. —



## Leading Features of the Esholt Sewage Disposal Scheme :

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MAIN OUTFALL SEWER from Frizinghall, 10 ft. diameter, circular, gradient 1 in 2,000, discharging capacity about 180 million gallons per day, in tunnel for about  $2\frac{3}{4}$  miles.

INTERCEPTING SEWER from Eccleshill and Idle, 2 ft. 4 ins. wide, by 3 ft. 6 ins. high, egg-shaped, gradient 1 in 630, discharging capacity about 12 million gallons per day.

DETRITUS TANKS. 2 tanks, 10 ft. deep, with a total capacity of about 1 million gallons.

AIRE VALLEY CROSSING to the Precipitation Tanks on the High Level.

PRECIPITATION TANKS. First Series of 20 tanks, average depth 7 ft. 8 ins., with a total capacity of about 8 million gallons.

Second Series of 20 tanks, average depth 10 ft. 2 ins., with a total capacity of about  $11\frac{1}{2}$  million gallons.

BACTERIAL FILTERS. 52 acres at the Apperley Bridge end of the Estate, and 8 acres at the Baildon end.

LAND IRRIGATION. About 400 acres, half surface irrigation only.

STORM WATER TANKS. 7 tanks, average depth 6 ft., with a total capacity of about  $11\frac{1}{2}$  million gallons.

SLUDGE DISPOSAL BUILDINGS AND WORKS at Strangford Hill, covering about 1 acre, and comprising : Grease House, Press House, Boiler House, and Engine House.

BRANCH RAILWAY from the Midland Main Line to the Works, and a

CANAL BASIN at the Works to berth 4 barges.





